

On some HEXACTINIÆ from New South Wales. By LEONORA J. WILSMORE, M.Sc., Zoological Laboratory, University College, London. (Communicated by Prof. J. P. HILL, D.Sc., F.L.S.)

(PLATES 4-6 and one Text-figure.)

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IN this paper I continue a description of the Actinaria brought from Australia by Professor J. P. Hill, to whom I am indebted both for material and for kindly advice and assistance. The classification employed is that adopted by Haddon in "The Actinaria of Torres Straits," (17) 1897. In the present communication the following species are classed as new :—

HEXACTINIÆ, Hertwig.

Family ILYANTHIDÆ, Gosse.

Subfam. Halcampinæ, Kwietn.

Peachia hilli, sp. n.

Family SARGARTIIDÆ.

Subfam. Phellinæ, Verr.

Phellia browni, sp. n.

Phellia capitata, sp. n.

PEACHIA HILLI. (Pl. 4. figs. 1-8.)

Form (Pl. 4. figs. 1 & 2).—The two specimens I received differ very much in size and outward appearance. The internal anatomy, however, shows that they undoubtedly belong to the same species, the smaller form being larval. The body consists of three parts—capitulum, scapus, and physa. There is no distinct division between the capitulum and scapus; but the physa is clearly defined, and in the adult appears as a small bud at the posterior end of the scapus (Pl. 4. fig. 1, *p.*). It measures 1.5 mm. in length, and shows none of the external grooves present in the physa of *Peachia hastata* (7), but their absence may be due to contraction. The peculiar form in which the posterior end of the scapus has contracted in the adult has no reference to its internal anatomy (Pl. 4. fig. 1, *s.*). The physa in the larval form is introverted, so that there appears to be a large pore at the posterior end. This is evidently the "anus large and conspicuous" of *Peachia carnea*, described by Professor Hutton (6). The entire surface is covered with minute projections, which are also characteristic of *Peachia hastata*. Professor Haddon (7) describes them as

suckers which "enable the anemone to hold itself upright against any smooth surface." Faurot appears to refer to the same projections as "pli de contraction" (15). A series of white, irregular, longitudinal lines are visible through the external walls of the scapus and capitulum. They agree in number with the mesenteries, and probably correspond to the insertion of the mesenteries in the column. Other lines, shorter, more irregular, and transverse, fill in the spaces between the longitudinal ones. In both polyps the œsophagus is partly extruded, so that description of mouth or disc is impossible. In the adult (Pl. 4. fig. 1, *œs.*), folds of the œsophagus envelop the oral end of the siphonoglyphe, and the tentacles—twelve, marginal, monocyclic, short and obtuse—are also largely concealed. The only one fully visible measures 2.5 mm. In the larval form (Pl. 4. fig. 2) the capitulum is retracted, and the single row of tentacles (Pl. 4. fig. 2, *tent.*), which vary in length from 1–1.5 mm., is fully visible with a crown of lobes above them. These lobes are the extruded œsophagus (Pl. 4. fig. 2, *œs.*), which, being held back at regular intervals by the mesenteries attached to the œsophageal walls, appears to be lobed.

It is characteristic of the genus *Peachia* that the tube of the siphonoglyphe ends orally in a conchula or external opening, independent of the mouth, the shape of this conchula varying in the different species (13). The siphonoglyphe is present as an open tube in both these examples of *Peachia*; hence the separate conchula is not present. In the adult the oral end of the siphonoglyphe is unfortunately not distinguishable from the loose folds of the extruded œsophagus which envelop it. The larval siphonoglyphe, visible to the naked eye, forms a deep, open, thick-walled gutter between two lobes of the œsophagus, and ends in simple thick rounded lobes which would form two complete lips were the gutter to close as a tube. Possibly in both specimens the degree of contraction has caused the tube to open.

Colour.—Sandy in spirit-specimens. Professor Hill states that it was cream-coloured when alive.

Dimensions.—Adult: Length 52 mm.; diameter varies considerably, greatest diameter 9 mm. Physa: Length 1.5 mm.; diameter 1.5 mm. Larval form: Length 20 mm.; diameter 5–2 mm. Physa introverted.

Locality.—Caught in a fishing-net off Clareville Wharf, Broken Bay, New South Wales, by Professor J. P. Hill, in 1893. Depth of water about four fathoms. Two specimens.

I have the pleasure of naming this, the first known Australian species of *Peachia*, in honour of the discoverer, Professor Hill.

Column-wall.—Sections of the column-wall have a characteristic appearance, owing to the numerous small projections or suckers (Pl. 4. figs. 3, 4, 5) on the surface. These are formed by long processes from the outer border only of the mesoglaea, covered by thin ectoderm, which, however, appears massive between the suckers, where the opposing faces of the ectoderm often

touch. The suckers are fewer and smaller in the contracted physa, which is covered by deeper ectoderm and presents a smoother external surface. The border of the ectoderm is thickly set with long oval nematocysts, lying at right angles to the surface (Pl. 4. fig. 5, *nem.*). These are most numerous in the capitulum and upper scapus, where they form a continuous border touching one another. The large glandular cells recognized by Faurot in *Peachia hastata* (15) are not distinguishable, probably owing to the state of preservation. The ectoderm cells are very long and contain rounded nuclei, internal to which lies the clear, slightly granulated, nervous layer. I have not been able to detect ectodermal muscle in my preparations. The mesogloea contains many isolated cells, and is laminated throughout the polyp, this lamination being most marked in the column-wall, where the laminæ are so thin as to give the whole structure a fibrous appearance.

The endodermal muscle system is strong and strengthened locally in both capitulum and lower scapus. The plaitings of the mesogloea, on which the muscle-cells are placed, line the capitulum and scapus throughout, and are present in the greater part of the physa also. These mesogloéal plaitings all contain a darker-staining centre core, surrounded by lighter-coloured supporting substance. In the capitulum and through the greater length of the scapus they are simple and, in longitudinal sections, have the appearance of a band of narrow wavy ribbon running down the column between the mesogloea and endoderm. In the lower scapus they become branched and finally assume a dendriform appearance, reaching their maximum strength in the scapus adjacent to the physa, where they form long tongues stretching into the coelenteron. On each side of these tongues are branches, which often divide again, thus largely increasing the surface (Pl. 4. fig. 5). Between these dendriform structures shorter projections are present. This is the strongest part of the body-wall, and it is these muscles, probably, which enable the animal to bore into the sand with its physa and to bury itself up to the capitulum. Holdsworth (3) and Faurot (15) have carefully described this process in the case of *Peachia hastata*, and estimated the time taken in boring at about an hour; but the endodermal muscles present in the scapus of any species of *Peachia* have not hitherto been described.

The endoderm of the column consists of long narrow cells, which are very easily separated from one another. The endoderm is narrow in the upper part of the polyp, but becomes extremely thick in parts of the physa, as does the ectoderm also. It is, however, probable that the physa is much contracted.

The Sphincter.—The sphincter is represented in *Peachia hilli* by an increase in strength of the endodermal muscle plaitings present in the capitular region. The plaitings remain simple and are still very small, but are nevertheless about twice the length of those present in the upper scapus.

Disc and Tentacles.—The tentacles are short and obtuse, with thin walls

enclosing a very large lumen. A single row of nematocysts of varying sizes is placed on the outer border of the ectoderm, more sparsely than in the column-wall. They are of two kinds, one only of which takes the hæmatoxylin stain. The nucleated zone is very deep, and the clear nervous zone is penetrated by numerous plaitings of the mesoglœa, which carry a strong ectodermal muscle. The mesoglœa and endoderm are thin. The histology of the disc resembles that of the tentacles, but a slight endodermal muscle is also present.

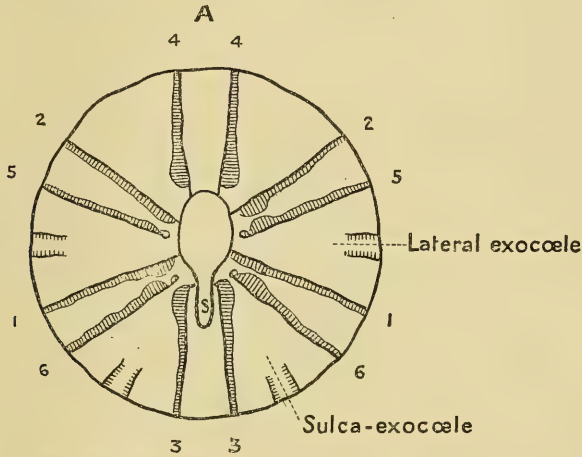
Œsophagus (Pl. 4. figs. 3 & 4).—The most striking feature of the œsophagus is the single enormous siphonoglyphe (Pl. 4. figs. 3 & 4, and text-figure A). This large firm structure extends from the mouth to a point in the body-cavity some distance below the rest of the œsophagus. Its total length in the adult specimen is 1·6 mm., and it terminates 3·7 mm. from the posterior end of the body.

The ventral directives (Pl. 4. figs. 3 & 7, 3 3, and text-figure A, 3 3), by which alone it is supported throughout, remain attached to it below the œsophagus, where it hangs freely in the body-cavity. In fig. 3 a dotted line shows the internal boundary of the siphonoglyphe. In the adult specimen it remains an open tube throughout and its walls enclose a space almost equal in area to the rest of the œsophagus. In the larval form the two endoderm walls are approximated at the entrance to the œsophagus during part of their length, and the siphonoglyphe encloses a relatively smaller area than in the adult.

The ectoderm is deeply folded and of equal thickness in both œsophagus and siphonoglyphe, but becomes thicker in the lower part of the siphonoglyphe. It contains many long gland-cells, especially numerous in the siphonoglyphe, and a row of fine small nematocysts lies in its outer border, while the nucleated layer is very deep. The mesoglœa is finely laminated in the adult; but in the larval form the laminae are very loose, and show also many light circular patches. The mesoglœa of the œsophagus proper is very thin; that of the siphonoglyphe extremely thick and stiff, but this thickness decreases somewhat in the lower part. The endoderm, which is thicker in the siphonoglyphe than elsewhere, is not sufficiently well-preserved for description.

Mesenteries (Pl. 4. figs. 3, 7, 8, and text-figure A).—There are in the adult form twelve perfect and eight imperfect mesenteries. The latter consist of four very small pairs situated in the lateral and sulcar exocœles (Pl. 4. figs. 3, 7, and text-figure A). Although no gonads are present the cœlenteron on dissection was found almost completely filled with a solid mass formed of the perfect mesenteries. This is markedly the case in the upper sub-œsophageal region, where the digestive endoderm is very thick and divides into several branches each provided with a mesenterial filament. Four pairs of the mesenteries, viz. 1 1, 2 2, 3 3, and 4 4, are attached to

the œsophagus throughout their length (Pl. 4. fig. 3, and text-figure A). The pairs 5 5 and 6 6, probably the last two pairs of mesenteries to be formed (15), are not attached to the lower half of the œsophagus in the adult form. Owing to the capitular region having been cut longitudinally, I have not been able to determine whether or not they are attached to the upper region of the œsophagus. In the larval form the twelve perfect mesenteries only are present. These are fully formed, bearing muscle-pads, digestive endoderm, and mesenterial filaments, and the pairs 5 5 and 6 6 are free throughout their entire course.



Diagrammatic section through lower œsophageal region of *Peachia hillii*.

The longitudinal retractor muscles are unilateral and exceedingly powerful. Distinctly narrower peripherally they widen towards their internal margin and end a short distance from the œsophagus in a large half renal curve (Pl. 4. figs. 3, 8). The long narrow mesoglœal processes on which the muscle-cells are placed frequently branch, and the processes show a central dark-staining core. A number of short thick muscular outgrowths occur on the mesentery between the longitudinal retractor and the œsophagus (Pl. 4. fig. 8, *mu.*).

The parietal muscle, bilateral and well-developed, is situated on short blunt processes of the mesoglœa (Pl. 4. fig. 8, *p.m.*). These on one side extend to a greater width and join the fibres of the longitudinal retractor, on the other in the perfect mesenteries they often form, especially in the œsophageal region, little tufts or brush-like outgrowths. The mesenteries diminish in width towards the posterior end of the column and with them the retractor muscles diminish also. At the posterior end of the scapus they form two groups (Pl. 4. fig. 7). One consists of the pairs 1 1, 2 2, and 3 3, which still retain some digestive endoderm. Of these, 3 3, formerly carriers

of the siphonoglyphe, remain the largest. The pairs 4 4, 5 5, and 6 6 have lost their digestive endoderm entirely and are of about equal size.

The incomplete mesenteries (Pl. 4. fig. 3, *imper.mes.*) have longitudinal retractor muscles on plaitings the same width throughout; their parietal muscle does not form tufts, and they are not provided with digestive endoderm or mesenterial filaments. At the posterior end of the scapus they are already very minute (Pl. 4. fig. 7, *imper.mes.*).

In the larval form there are present twelve tentacles and twelve fully-developed perfect mesenteries, two pairs of which, viz., 5 5 and 6 6, are unattached to the œsophagus. All twelve have muscle-pads, digestive endoderm, and mesenterial filaments. No mesenteries of the second cycle are present.

Physa.—In this region there are a number of pores through the body-wall. There is no external evidence of their presence, and some of the sections being broken, I am unable to give their total number, but have counted over sixty. The physa was cut longitudinally, and I cannot determine whether, as in some species of *Halcompa*, there is a central pore, round which the others are arranged. These pores are placed in longitudinal rows, and are much more numerous in the lower half of the physa than in the upper. Two or three occur on adjacent parts of the scapus. Pl. 4. fig. 6 (1, 2, 3, 4, 5) shows a longitudinal section of the physa-wall with five of these pores cut through in different parts of their course. The mesogloea between the small suckers of the physa is extremely thin and covered with a thin layer of ectoderm, and at these points the pores are formed. They open into the ectodermal cavities between the suckers (Pl. 4. fig. 6, *po.*), and in this way a free passage is formed to the exterior. The passage formed by the pore itself through the ectodermal layer is, therefore, extremely short.

On the ectodermal side the pores are thickly lined with columnar cells, whose numerous rounded nuclei lie internal to a clear border, containing only an occasional nematocyst (Pl. 4. fig. 6). On the endodermal side the cells are shorter and the nuclei larger. A large increase of endodermal cells is present adjacent to the pores, and through these the passage has been formed to the interior of the body-cavity. The endodermal passage is therefore much longer than the ectodermal.

Gonads.—No gonads were present in the two specimens examined.

Development.—The larval form examined had twelve tentacles and twelve perfect mesenteries. Of these the eight primitive Edwardsian septa were alone complete. The four unattached mesenteries are fully developed and possess muscle-pads and mesenterial filaments. This shows a variation in the development of mesenteries and tentacles as compared with the larval stage of a species of a closely allied species, viz. *Halcompa duodecimcirrata*, described by Carlgren (14, p. 42). Carlgren found that larval forms possessing twelve tentacles had all twelve mesenteries attached in the *upper* part of the œsophagus, and were at that stage already in possession of some mesen-

teries, the second cycle. Even younger forms, having only ten tentacles showed the second cycle of mesenteries developing.

Haddon (9) also in describing larval forms of *Halcampa crysanthellum*, which, like those of this larval form, had twelve mesenteries, found that at a stage where the mesenteries 5 5, 6 6, were unattached in the lower œsophagus there were present only eight tentacles. This is the more interesting since Faurot (15) believes Haddon to be mistaken in the classification and considers the larva described to be that of *Peachia hastata*. The fact that the siphonoglyphe figured by Haddon continues below the œsophagus certainly points in that direction.

Our knowledge of the genus *Peachia* is very scanty. The description even of the type species *Peachia hastata* is incomplete and contradictory. It is first mentioned by Reid in 1848 (1) under the name of *Actinia cylindrica*, a name preoccupied. Gosse renamed it *Peachia hastata* in 1855 (2). McIntosh (10) has described the commensal habits of the larval *Peachia*. From that time its occurrence and external appearance have been noted by various zoologists. Haddon and Dixon (7) summarize the literature to the date of their paper and give an excellent account of the habits and external structures of this anemone. Haddon deduced the existence of pores in *Peachia* from the grooves present externally on the physa of *Peachia hastata* (7), which he considered comparable with the external openings of pores in *Halcampa*. "Mr. Dixon and myself are now satisfied that such (*i. e.* pores) is the true explanation of the appearance we described in *Peachia*" (7 and 8). He included them in his definition of *Peachia*, but has not described them further (11). But Faurot (15, p. 140) some nine years later in describing the movements and actions of living *Peachia hastata* lays emphasis on his opinion that the water with which it fills its body-cavity at this time is ejected entirely by the mouth, by adding "*un orifice à l'extrémité basale n'existe pas.*" That the apparent orifice caused by introversion, and mistaken for a pore by older writers, is not one, is of course certain, but Faurot overlooked the existence of these very numerous pores round the physa of *Peachia hastata*, which, indeed, may serve the very purpose of ejecting water. Still it is to Faurot (15) we owe most of our knowledge of the internal anatomy of *Peachia hastata*. But his excellent paper on the comparative anatomy of several genera of *Actiniæ* does not profess to deal with all their organs. In addition to the above omission, he does not mention the powerful endodermal muscle-system of *Peachia*, denies the existence of a sphincter, and gives an account of several minor structures differing from that given by Haddon.

I have therefore dealt with the anatomy of all the organs of *Peachia hastata* as fully as the condition of my material allowed. I have followed Haddon (11) in describing the bulk of the muscle on the imperfect mesenteries longitudinal retractor. Faurot (15), on the other hand, considers that

the imperfect mesenteries have no longitudinal retractor muscles, that their entire muscle and a corresponding width of muscle on the perfect mesenteries is parietal, and that therefore in the lower part of the scapus in *Peachia hastata* parietal muscle alone is present.

In the size of the perfect mesenteries, in their attachment to the œsophagus, and in their relative width in the subœsophageal region, *Peachia hilli* differs from *Peachia hastata*. In *Peachia hastata* the pair 6 6 alone, the the last pair formed, “deviennent libres dans les deux tiers inférieures de la région œsophagienne” (15). In that species towards the end of the scapus the pair 4 4 does not form a group with 5 5 and 6 6, but has already diminished to the size of the imperfect mesenteries. Faurot photographs (15) show that at a lower level still, roughly corresponding to fig. 7, the pairs 5 5, 6 6 in *Peachia hastata* have also diminished to the same size as 4 4. In *Peachia hilli* these pairs retain their relatively greater width well into the physa.

Professor McMurrich (13) has altered the generic characters as defined by Haddon to include *Peachia koreni*. Although, on account of his unwillingness to mutilate his only specimen, he has not been able to describe the species in detail, there is no doubt that it is a totally distinct species from *Peachia hilli*. In *Peachia koreni* the conchula is as large as the tentacles, of which there are only eight, though all six pairs of perfect and four pairs of imperfect mesenteries are present. There is also in the American form no distinction into capitulum, scapus, and physa. This example of *Peachia koreni* may be a young form, but, if so, its tentacles and mesenteries are developing in reverse order to those of the larval form of *Peachia hilli*.

Peachia hilli is the second species of this genus recorded from the Pacific. The first, *Peachia carnea* (6), found on the beach, Dunedin, New Zealand, differs from *Peachia hilli* in being flesh-coloured. Only the external characteristics of this anemone have been given by Hutton, and since these apply equally well to the genus *Halcampa* as to *Peachia*, its position is quite uncertain. Another form from the Southern Hemisphere, *Peachia antarctica* (South Georgia), was classed as a *Peachia* by Pfeffer on its external characters only, in his “Zur Fauna von Süd-Georgien,” Jahr. Hamb. Anstalt, vi. Jahrg. 1888. In 1898 Carlgren found that this was in reality a *Scytophorus* and renamed it *Scytophorus antarcticus* (23).

PHELLIA BROWNI. (Pl. 5. figs. 9–13.)

Form (Pl. 5. figs. 9 & 9 a).—Single, conical, fixed; scapus and almost the whole of the capitulum thickly covered with large yellow, brown, and white grains of calcareous sand; beneath these lies a thick coating of transparent siliceous grains. This sand forces itself irregularly into the column-wall, but does not penetrate the surface, so that the indentations in which it lies are completely lined by ectoderm coated by mucus. The grains are best

removed by careful scraping under a dissecting microscope, but this operation needs care, as small fragments are deeply embedded. Their removal leaves exposed a roughened deeply pitted surface of spongy appearance (Pl. 5. fig. 10), and discloses at point of closure of the capitulum six deep longitudinal ridges (Pl. 5. fig. 9), which continue distally down fully two-thirds of the inverted portion. Where the ridges cease, a circular groove with deep folds in its surface (Pl. 5. fig. 10, *c.g.*) runs round the capitulum. Immediately below this spring out a large number of thin, naked, nose-like projections, which completely close the entrance to the oral disc, when, as here, the capitulum is inverted (Pl. 5. fig. 10). These thin nose-like projections are entirely free from both sand and mucus. The pedal disc does not extend beyond the general body of the polyp, which reaches its greatest width in the pedal region. The tentacles, short, blunt, and marginal, are transversely grooved and number over 40 (Pl. 5. fig. 10). They are placed in several cycles which are difficult to distinguish. Those in the innermost cycle are the longest, and measure 2.5 mm.; the shortest measure .5 mm.

Colour.—Professor Hill states that the anemone was sand-coloured in life. In spirit it is unchanged.

Dimensions.—Somewhat irregular in shape; narrower distally. Greatest height 11.5 mm.; greatest diameter 9 mm.; diameter at capitulum 4.5 mm. (Pl. 5. fig. 9 *a*).

Locality.—Collected by Professor Hill in 1894, on the Pacific Ocean beach opposite Creel Bay, Broken Bay, New South Wales.

I wish to associate with this species the name of Mr. E. T. Browne, the well-known authority on medusæ, to whom I am indebted for kindly assistance.

Column-wall (Pl. 5. figs. 10 & 13).—The surface of the polyp is deeply indented and covered below the sand-grains with a yellow mucous layer in which numerous small foreign particles are embedded. I have not been able to fully determine the presence of a cuticle, but the ectoderm is badly preserved and has been much torn in scraping off the sand. The ectoderm of the capitulum contains numerous nematocysts present everywhere, but occurring most abundantly in the soft nose-like projections. The mesoglæa is thick, finely fibrous, almost homogeneous, and doubles its width in the capitular region. It contains numerous isolated cells and small lacunæ. The endoderm is deep and deeply folded, especially in the capitulum. Endodermal muscle on long plaitings of the mesoglæa lines the cœlenteron throughout; these muscle-plaitings are still further developed and become slightly branched in the region of the proximal part of the sphincter (Pl. 5. fig. 10, *end.m.*).

Sphincter (Pl. 5. figs. 10 & 11).—The sphincter muscle, large, powerful, and mesoglæal, is peculiar in form. It recalls the double sphincter of

Zoanthus, but here the two portions are connected. The proximal portion is much the longer, of compact form, of almost uniform width, and much nearer the endoderm than the ectoderm. The second, or distal, expansion occurs in the soft nose-like projections of the capitulum. These projections vary in shape, and this portion of the sphincter varies with them, since it occupies the whole width of the mesogloea here present, and runs into all but the finest branches of the projections. The narrow strip connecting the distal and proximal part of the sphincter lies in the circular depression round the capitulum (Pl. 5. fig. 10). The muscle-cavities are closely pressed together, polygonal in shape, and only broken by narrow irregular strands of mesogloea passing transversely (Pl. 5. fig. 11). In transverse sections the sphincter shows a straight line on the endodermal, while on the ectodermal side a large wave enters the base of each ridge of the capitulum.

Tentacles (Pl. 5. figs. 10 & 12).—The tentacles are thick-walled, containing a small lumen. The annular grooves on their surface involve the ectodermal layer alone, which is very thick and has in its external border a closely packed row of nematocysts placed at right angles to the surface (Pl. 5. fig. 12). The strong ectodermal muscle is placed on long branched mesogloéal processes which end in the nervous zone of the ectoderm. Since they are not enclosed by mesogloea on the ectodermal side, and the branches do not anastomose, the fibres are not mesogloéal in position (Pl. 6. fig. 12). The mesogloea is narrow and homogeneous, supporting a slight endodermal muscle. The endoderm is deep and deeply folded.

Disc.—The histology of the disc closely resembles that of the tentacle. The ectoderm is deep with an outer border of nematocysts, and the strong ectodermal muscle is placed on long branched mesogloéal processes, which end in the nerve zone of the ectoderm. These mesogloéal processes branch, but do not anastomose with one another, and therefore the muscle remains ectodermal in position. This muscle becomes deeper towards the point of junction of the perfect septa. The ectoderm of the disc is much narrower than that of the tentacles.

Œsophagus (Pl. 5. fig. 13).—The polyp was cut through the œsophageal region transversely, the cut surface of the lower half being represented in the figure. Twelve deep longitudinal grooves are present. Of these, the two grooves which occupy the normal position of siphonoglyphes, *i. e.* which lie between the points of attachment of the two ventral and the two dorsal directives respectively, are not much deeper than the other ten, but the specimen is greatly contracted. There are also present, probably owing to contraction, a number of very deep transverse grooves. The tissues are not well enough preserved for histological purposes. The ectoderm, which is deep, contains numerous gland-cells. The mesogloea, fibrous and thin in the long grooves, widens immensely in the lobes between the longitudinal grooves, and these contain numerous enclosed cells. The endoderm is narrow.

Mesenteries and Acontia (Pl. 5. fig. 13, *mes.*, *a.*).—There are three cycles of mesenteries; the formula for each sextant being P11111P. The mesenteries of the first cycle number six pairs, including two pairs of directives (Pl. 5. fig. 13, *me.*¹). They alone are perfect and carry the gonads; there are also six pairs of imperfect mesenteries of the second (Pl. 5. fig. 13, *me.*²) and twelve pairs of the third cycle (Pl. 5. fig. 13, *me.*³), all of which are in a very rudimentary state. There is no trace of a fourth incomplete cycle present in several of the species already described, and the suggestion, therefore, of Kweitniewski (21) that the partial development of the fourth cycle might be a generic character is incorrect. This fourth cycle is absent also in *P. vermiformis*.

Perfect Mesenteries.—The longitudinal retractor muscle of the perfect mesenteries is contained in a muscle-pad which is large and reniform in cross-sections. The distal end and external appearance of this muscle-pad is shown in fig. 10, *m.p.*, Pl. 5. It continues proximally to within a short distance of the pedal disc. The muscle-cells are situated on slight, long, very numerous and richly-branched processes (Pl. 5. fig. 13, *l.r.m.*). Distally, beyond the level of this muscle-pad, short blunt muscular processes occupy the greater width of the perfect mesenteries. Here the mesogloea is thicker and contains isolated cells. The perfect mesenteries are also supplied with a strong parieto-basilar muscle on plaitings of the mesogloea. This is produced on one side into a long brush-like tuft (Pl. 5. fig. 13, *p.h.m.*). The mesenterial filaments of the perfect mesenteries are divided into several branches. A septa is apparently present in the perfect mesenteries, but owing to tears caused by removal of sand and to imperfect preservation this point could not be decided.

Incomplete Mesenteries (Pl. 5. fig. 13, *me.*², *me.*³).—The incomplete mesenteries of the second and third cycles are rudimentary, without gonads, mesenterial filaments, or muscle-pads. They possess strong blunt muscle processes slightly branched on side. The mesenteries of the second cycle are only slightly wider than those of the third. In the region of the pedal disc, where the perfect mesenteries are narrower and have lost their muscle-pads, the internal borders of all three cycles become connected together in groups. The largest group consists of 16 mesenteries, whose inner border forms part of a circle lined by muscle processes. Examples of somewhat similar coalescences of several mesenteries of different cycles have already been recorded by Dixon (12) and by Parker (19).

The *Acontia* (Pl. 5. figs. 10, *a.*, 13, *a.*) are very large and are visible immediately on opening the cœlenteron. They form very white coiled tubes of considerable length, some of which pass well into the capitulum (Pl. 5. fig. 10, *a.*). Transverse sections show that they are rounded and one side is fully armed with nematocysts, but the histology is not well preserved. No inclides are visible.

Gonads (Pl. 5. fig. 13, *gs.*).—The specimen was a female. The gonads, which were carried by the six pairs of perfect mesenteries, almost filled the cœlenteron. Transversely they extended from the œsophagus to the body-wall, passing into the spaces between the imperfect mesenteries, longitudinally, from the level of the mouth to a little above the pedal disc. The immense number of ova present were in different stages of growth.

PHELLIA CAPITATA. (Pls. 5, 6. figs. 14–19.)

Form (Pl. 5. fig. 14).—Single, fixed; capitulum slightly swollen; base much broader, there being a gradual increase from the centre of the column to the pedal disc, which expands broadly beyond the column-wall; surface of the scapus irregularly pitted and gritty with fine sand; on the capitulum the sand very sparse and the irregularities of the surface arranged in deep transverse grooves; the greater part of the capitulum and the scapus beneath the sand-grains covered with thick yellow mucus, in which small objects are embedded; the small distal portion of the capitulum delicate, free from mucus and sand, quite smooth and light sand-coloured. In the specimen examined this portion pressed outwards forms a ridge protruding round the anterior end of the polyp between the transverse grooves of the lower capitulum and the expanded tentacles (Pl. 6. figs. 15, 16, 19, *d.cap.*). Tentacles (Pl. 5. fig. 14, Pl. 6. figs. 15, 16) short, slightly annulated, in two cycles, the inner the larger; 39 present, and a space about equal to one-eighth the circumference of the disc, which is devoid of tentacles, has several minute buds at long intervals. The œsophagus is extruded together with masses of the gonads (Pl. 5. fig. 14, *œs., gs.*); owing to the attachment of the perfect mesenteries to the inner wall of the œsophagus this organ is slightly lobed in extension; its lower border is deeply grooved transversely. There is no indication of a siphonoglyphe.

Colour.—Brown in spirit, owing to minute dark brown pigment spots which cover the surface to the edge of the light-coloured naked distal parts of capitulum.

Dimensions.—Height 13 mm.; average diameter 5 mm., diameter at pedal disc 9 mm.

Locality.—Collected by Professor Hill in 1894; on the Pacific Ocean beach opposite Creel Bay, Broken Bay, New South Wales.

This species is named *Phellia capitata* on account of the peculiar swollen heads of the longitudinal retractor muscles of the mesenteries.

Column-wall (Pl. 6. figs. 15, 17).—The column-wall, narrow below, owes its greater width distally to the inclusion of a wide mesoglœal sphincter (Pl. 6. fig. 15, *sph.*). Its surface is very irregular, but the sand-grains with which it is covered do not penetrate into the deeper indentations. They adhere chiefly to the surface of the yellow abundant mucus, and are

therefore more easily removed than in *Phellia browni*, and the underlying structures are less destroyed in the process. Both mucus and a cuticle cover the surface of the ectoderm of the column and lower capitulum, and the ectoderm underlying these structures is narrow and badly preserved. In the naked distal portion of the capitulum the ectoderm is much wider (Pl. 6. fig. 15, *d.cap.*), consisting of very deep columnar cells, and nematocysts, which are not numerous, appear to be confined to this portion.

Small ill-defined bodies, probably badly preserved isolated cells, are scattered irregularly through the mesogloea and occur in the sphincter also, where they are easily detected, being of much larger size and staining deeper with carmine than the muscle-cells of the sphincter itself. An endodermal muscle lining the coelenteron is present on unbranched mesogloéal plaitings, which do not appear to be further developed in the capitular region (Pl. 6. fig. 15, *end.m.*). The endoderm forms deep triangular ridges between the mesenteries (Pl. 6. fig. 17, *end.*).

Sphincter.—The sphincter, large and mesogloéal, lies throughout its course nearer the endoderm than the ectoderm (Pl. 6. fig. 15, *sph.*). Less powerful than in *Phellia browni*, it has the same double form as in that species, lying chiefly in the lower capitulum, with a second marked expansion in the naked distal portion where it occupies the full width of the mesogloea. The muscle-cavities are very numerous, small, oval or round, lined with muscle-cells and embedded in an irregular manner in the mesogloea. These cavities lie singly and retain their own shape, but there are very few scattered cells, and the shape of the sphincter as a whole is compact. The naked portion of the capitulum and the distal expansion of the sphincter which it contains are more or less constant in shape in this specimen, thus forming a great contrast to the long prolongations of both capitula of the sphincter which are present in the last species, *Phellia browni*. This difference is probably not specific, but the result of *Phellia capitata* being in full expansion, while *Phellia browni* is in a contracted state. See Verrill (4) on the sphincter of *Phellia panamensis*, later named *Phelliopsis panamensis* (22). The ectodermal side of the sphincter is irregularly waved, and it reaches its greatest width at about the centre of its length.

Tentacles (Pl. 6. figs. 15, 16).—The tentacles are thick-walled with a small lumen. The ectoderm, the broadest of the three layers, is well supplied with nematocysts and has a broad nervous zone. The ectodermal muscle is powerfully developed on branched processes of the mesogloea, which end in the nervous zone of the ectoderm, as in the last species, and are therefore not mesogloéal in position. Short and almost unbranched on the outer side of the tentacle, these mesogloéal processes are at least twice as broad on the inner side which faces the oral aperture (Pl. 6. figs. 15, 19, *ect.m.*¹, *ect.m.*²). The mesogloea, which is narrow, bears on its internal border a well-marked ectodermal muscle. The endoderm is deeply folded.

Disc (Pl. 6. fig. 19, *d.*).—The musculature of the disc and tentacles in the former species alike, are in this species very different. The ectodermal muscle of the disc is only slightly developed and strongly resembles that of *Phellia sollasi* (20), another Australian species. A few mesogloæal processes are present peripherally. More centrally these processes are absent and the muscle very feebly developed. The endoderm is narrower than in the tentacles and very few nematocysts are present in the ectoderms.

Mesenteries and Acontia (Pl. 6. fig. 17).—There are three cycles of mesenteries, the formula for each sextant being the same as in the last species, viz. PULLIP. The perfect mesenteries are of the first cycle only, number six pairs including the directives, and carry the gonads; there are also six pairs of imperfect mesenteries of the second and twelve pairs of imperfect of the third cycle.

Perfect mesenteries. A surface view of the distal part of a perfect mesentery, as it appears on opening the anterior end of the polyp longitudinally, is shown in Pl. 6. fig. 16. It will be seen that the longitudinal retractor muscle has a most unusual form. Throughout the greater length of the mesentery it consists of a muscle-pad of uniform and very narrow width (Pl. 6. fig. 16, *m.p.*), but at its distal extremity it increases suddenly in size and ends in a large bulb or head (Pl. 6. fig. 16, *m.b.*). The œsophagus, which is attached to the perfect mesenteries and does not extend below the level of the enlarged heads, has, in eversion, drawn the mesenteries upwards and outwards. The position of the heads of the muscle-pads in the lobes of the everted œsophagus is due to this fact, and their curvature probably arises from the same cause.

The internal structure of the muscle-pad and its enlarged head are shown and compared in Pl. 6. figs. 17, 18, & 19. In longitudinal and transverse sections of the head (figs. 18, 19) it will be seen that the structure consists entirely of very numerous delicate processes branching from a mesogloæal core, the muscle-cells being situated on these processes. The muscle-pad shown in transverse section (fig. 17, *m.p.*) is drawn on the same scale as the muscle-head in fig. 18. In structure the muscle-pad differs from the muscle-head only in the fact that the mesogloæal core is much slighter in the pad and does not penetrate so deeply. In shape also the transverse section of the pad is more reniform than that of the head.

The marked difference in the form of the retractor muscle in this species and in *Phellia browni* may be seen by comparing fig. 10 on Plate 5 with fig. 16 on Plate 6.

The mesenterial filament is very small; immediately below the œsophagus it is divided into three parts; lower down it is single (Pl. 6. fig. 17, *me.³*).

The parieto-basilar muscle, which is present in the perfect mesenteries only, forms a well-developed brush-like tuft on that side of the mesentery

which is opposite to the longitudinal retractor muscle. It has a depth equal to that of the third cycle of mesenteries (Pl. 6. fig. 17, *p.m.*).

The incomplete mesenteries (Pl. 6. fig. 17, *me.*², *me.*³) of the second and third cycles are very rudimentary and closely resemble the corresponding mesenteries in *Phellia browni*. Their feathery appearance in both cases is due to muscle processes of the mesoglœa on each side. They are devoid of gonads and muscle-pads. Owing to imperfect preservation I am unable to decide whether a slight mesenterial filament is present on the mesenteries of the second cycle or not, but the mesenteries themselves are quite rudimentary and scarcely longer than those of the third cycle. The perfect and imperfect mesenteries of *Phellia capitata*, unlike those of *Phellia browni*, do not approximate in width towards the pedal disc or become connected with one another. The complete mesenteries in the proximal end of the body meet in the centre of the pedal disc, to which their basal extremities are attached. The incomplete mesenteries are also attached to the pedal disc, but they are narrower and end at varying distances from its centre. The pedal disc, therefore, has a great number of radial lines at its circumference, twelve of which, representing the attachment to the perfect mesenteries, meet in the centre.

The Acontia (Pl. 6. fig. 17, *a.*).—The acontia are numerous, thick, and long, but not so dead white as in the former species, and therefore not so prominent at first sight. Transverse sections (Pl. 6. fig. 17, *a.*) show a round figure with a groove on one side. The opposite or convex side is strongly armed with nematocysts, and there is an axis of connective tissue. In form, therefore, the acontia of both *Phellia browni* and *capitata* closely resemble the acontia described by Hertwig (5) in *Cercus spinosus* and *Callietis parasitica*, and are unlike those figured by Carlgren for *Sagartia viduata*, *Sagartia undata*, *Metridium dianthus*, and *Chondractinia* (14). Unfortunately the muscle-fibres, which Hertwig says "lie on the convex side of the mesoglœa, where the nematocysts lie," and which Carlgren finds in every acontium examined by him "auf der den Nesselzellen entgegengesetzten Seite," are here not well enough preserved to distinguish.

Gonads (Pls. 5, 6. figs. 14, 16, *gs.*).—The specimen was a male and the gonads, carried by the perfect mesenteries only, were extremely well developed and formed large bunches, partly extruded with the œsophagus; they also almost filled the cœlenteron distally, but diminished in size proximally. In the specimen examined it appeared that the perfect mesenteries ceased to bear gonads at different levels, but the state of preservation is not good enough to determine the point. The spermatozoa present are not fully ripe.

These two Australian species are characterized by the unusual strength of the sphincter and its peculiar contraction into two parts, which does not occur in other known species of the genus. The size and prominence of the

acontia are also unusual characteristics. Haddon and Knietniewski, indeed, consider smallness of the acontia a generic character (21). *Phellia browni* (and in less degree *Phellia capitata*) is distinguished also by the thickness of its sand-incrustation.

The known species of *Phellia* from the Pacific—viz., *Phellia vermiformis* (17) from Torres Straits and *Phellia sollasi* (18 and 20) from Funafuti, *Phellia ternatana* (16) from Ternati, and *amboniensis* (21) from Ambon—differ widely from those here described in the three characters named above. Other points of difference are the external shape and the form of the longitudinal retractors, and the mesenteric formula of *Phellia sollasi*, *ternatana*, and *amboniensis*. Haddon's collection included two other anemones from Torres Straits, which he had "no doubt were *Phellia*." They were, however, lost before examination, and their external characteristics alone are given. These do not agree with those of *Phellia browni* and *capitata*. Until re-discovered, their position is in reality doubtful, since the external characters of *Phellia* and *Chondractinia* are alike, the fact that *Phellia* bear the gonads on the perfect mesenteries being the point of difference between the two genera.

An interesting series of stages of development of the ectodermal muscle of the disc is shown in the genus *Phellia*. In *Phellia sollasi* and *Phellia capitata* we find it at its lowest stage. A few fibres, stronger near the capitulum, are all that are present. In *Phellia browni* these fibres are large and branched and present over the whole disc, while in *Phellia ternatana* anastomosing of the branches has taken place to some extent, and the ectodermal muscle is now partly mesogloæal in position. This process is carried still further in *Phellia amboniensis*. Whole bundles of muscle-fibres are here enclosed by the anastomosing of the mesogloæal branches, which are 3-4 times as wide as the mesogloæa itself, but as yet very few of these fibres have sunk into the mesogloæa. A step further in the development would give ectodermal muscle of the disc as mesogloæal in position as that of a mesogloæal sphincter which originates from endodermal muscle.

Although the partial division of the sphincter into two parts seems to be peculiar to *Phellia browni* and *capitata*, the fact that it enlarges at its narrower distal end to fill the whole of the mesogloæa has been noticed by other observers, viz. Knietniewski (16) and McGuire (20). May this not be generic?

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Lettering.

<i>a.</i> Acontium.	<i>me.</i> ¹ , <i>me.</i> ² , } Mesenteries of 1st, 2nd, and 3rd <i>me.</i> ³ } cycle.
<i>c.</i> Cuticle.	
<i>c.g.</i> Circular groove of capitulum.	
<i>d.cap.</i> Distal portion of capitulum.	
<i>d.sph.</i> Distal portion of sphincter muscle.	
<i>ect.</i> Ectoderm.	
<i>ect.m.</i> Ectoderm muscle.	
<i>end.</i> Endoderm.	
<i>end.m.</i> Endoderm muscle.	
<i>gr.</i> Groove.	
<i>gs.</i> Gonads.	
<i>imper.mes.</i> Imperfect mesentery.	
<i>m.</i> Mesogloea.	
<i>m.1</i> , <i>m.2.</i> Different lengths of ectodermal muscle in tentacles.	
<i>m.b.</i> Bulb or head of long retractor muscle of mesentery.	
<i>mes.</i> Mesentery.	
	<i>m.f.</i> Mesenteric filament.
	<i>m.p.</i> Muscle-pad of long retractor muscle of mesentery.
	<i>mu.</i> Muscle.
	<i>muc.</i> Mucus.
	<i>nem.</i> Nematocysts.
	<i>æs.</i> Œsophagus.
	<i>p.</i> Physa.
	<i>p.b.m.</i> Parieto-basilar muscle.
	<i>p.m.</i> Parieto muscle.
	<i>po.</i> Pore.
	<i>s.</i> Scapus.
	<i>sd.</i> Grains of sand.
	<i>si.</i> Siphonoglyphe.
	<i>sph.</i> Sphincter.
	<i>su.</i> Sucker.
	<i>tent.</i> tentacle.

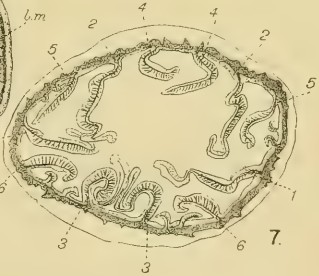
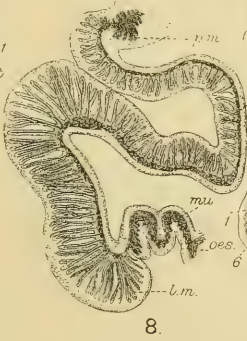
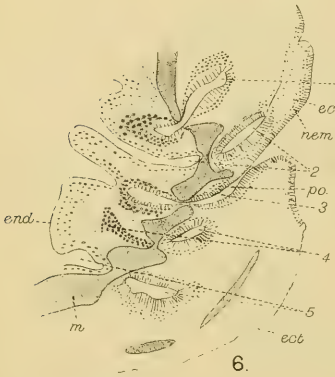
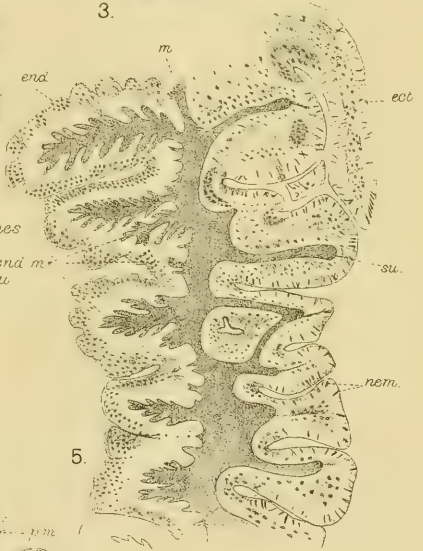
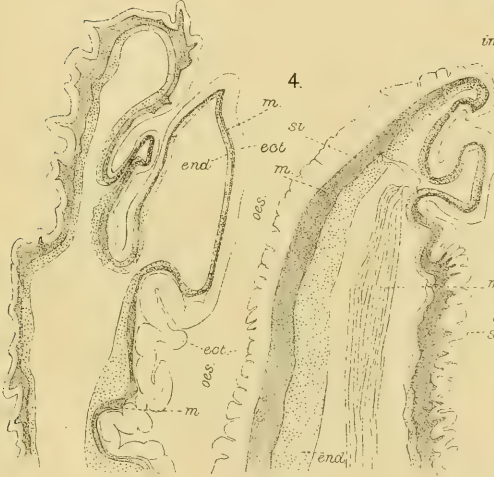
EXPLANATION OF THE PLATES.

PLATE 4.

- Fig. 1. *Peachia hilli*. × 2.
 2. *Peachia hilli*. Larval form. × 2.
 3. *Peachia hilli*. Transverse section through œsophageal region. × 12.
 4. *Peachia hilli*. Longitudinal section through capitular region. × 14.
 This section passes through the œsophagus and shows the thick wall of the siphonoglyphe on the right-hand side.
 5. *Peachia hilli*. Longitudinal section through the lower end of the scapus, showing strong development of endodermal muscle. × 68.
 6. *Peachia hilli*. Longitudinal section through part of physa, showing five pores. × 188.
 7. *Peachia hilli*. Transverse section through lower scapus near physa. × 12.
 8. *Peachia hilli*. Perfect mesentery. × 52.

PLATE 5.

- Fig. 9. *Phellia browni*. End view. × 3.
 9a. *Phellia browni*. Side view. × 3.
 10. *Phellia browni*. Longitudinal hand-cut section through capitular region. The sand-grains are removed from the lower half, leaving the rough deeply pitted surface exposed. Drawn under dissecting microscope.
 11. *Phellia browni*. Longitudinal section through sphincter. × 188.
 In upper part the endodermal muscle is figured attached to a mesentery, in the lower part it is represented lined by the endoderm of the column-wall.



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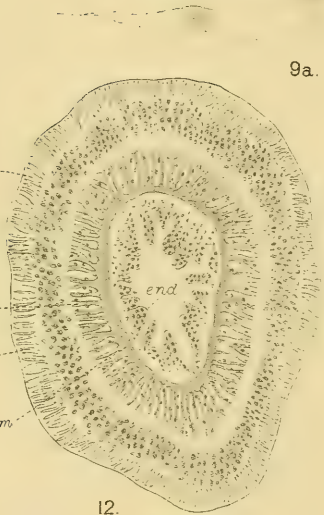
NEW HEXACTINÆ.

E Wilson, Cambridge.



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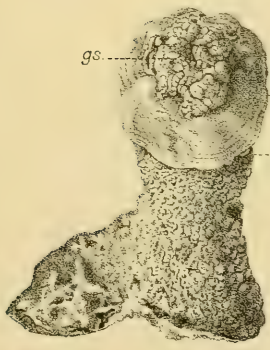
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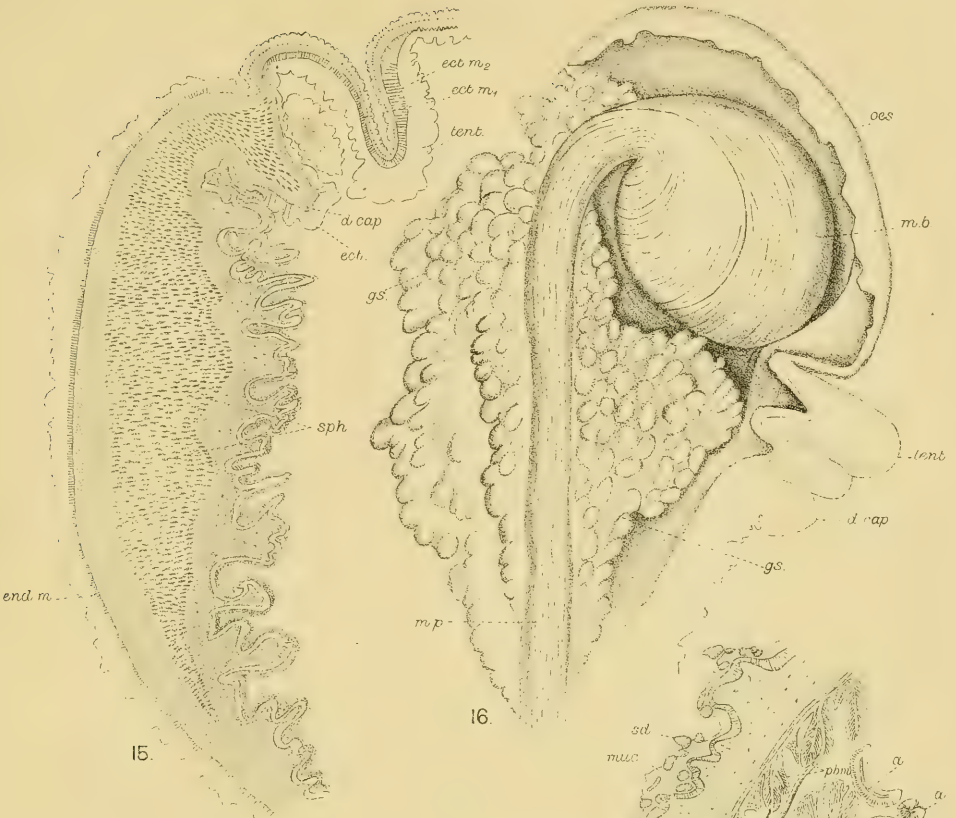
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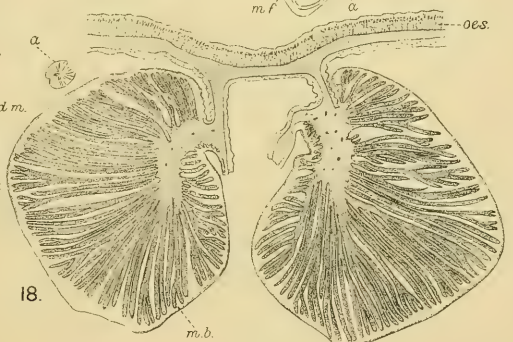
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17.



19.



18.

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- Fig. 12. *Phellia browni*. Transverse section through a tentacle. $\times 282$.
Shows large development of ectodermal muscle.
13. *Phellia browni*. The polyp was cut in two transversely through the œsophageal region. This figure represents the lower half viewed as a solid object. Drawn under a dissecting microscope. $\times 12$.
14. *Phellia capitata*. $\times 3$.

PLATE 6.

- Fig. 15. *Phellia capitata*. Longitudinal section through sphincter and tentacles. $\times 44$.
16. *Phellia capitata*. Longitudinal retractor muscle *in situ*. The everted œsophagus has been cut open longitudinally, and the gonads and muscles are exposed to view. Drawn under a dissecting microscope.
17. *Phellia capitata*. Transverse section showing examples of the three cycles of mesenteries. $\times 52$.
18. *Phellia capitata*. Transverse section through enlarged heads of two longitudinal retractor muscles. $\times 52$.
19. *Phellia capitata*. Longitudinal section through œsophagus, disc tentacles, and muscle-head of retractor muscle. $\times 34$.
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